RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

	COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	197,507	213,822	206,149	204,094	202,046	199,897	197,822	Continuing	TBD
612301	Physics	21,401	25,690	22,038	21,952	21,964	22,126	22,700	Continuing	TBD
612302	Solid Mechanics and Structures	17,325	15,907	11,489	11,258	11,157	10,872	10,457	Continuing	TBD
612303	Chemistry	24,304	27,215	26,735	26,681	26,693	26,635	27,421	Continuing	TBD
612304	Mathematical and Computer Sciences	32,388	32,557	33,153	32,683	32,237	31,590	30,971	Continuing	TBD
612305	Electronics	22,021	24,144	24,246	24,082	23,710	23,247	22,728	Continuing	TBD
612306	Materials	11,407	13,102	14,082	14,200	14,246	14,378	14,920	Continuing	TBD
612307	Fluid Mechanics	6,766	9,858	9,712	9,769	9,886	10,103	10,616	Continuing	TBD
612308	Propulsion	13,766	20,027	18,648	18,486	18,390	18,413	18,540	Continuing	TBD
612310	Atmospheric Sciences	5,217	5,594	0	0	0	0	0	Continuing	TBD
612311	Space Sciences	6,404	8,524	14,894	14,786	14,768	14,866	15,054	Continuing	TBD
612312	Biological Sciences	12,256	13,326	13,556	13,671	13,632	13,540	13,481	Continuing	TBD
612313	Human Performance	11,790	13,057	13,211	12,708	12,307	11,929	10,934	Continuing	TBD
614113	External Research Programs Interface	12,462	4,821	4,385	3,818	3,056	2,198	0	Continuing	TBD

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Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2001, Project 612310, Atmospheric Sciences, is eliminated with space sciences efforts being moved into Project 612311, Space Sciences.

(U) A. Mission Description

This program, managed by the Air Force Office of Scientific Research (AFOSR), comprises extramural research activities in academia and industry and in-house investigations in Air Force laboratories. The program element funds fundamental broad-based scientific and engineering research in technologies critical to the Air Force mission. These technologies include physics, solid mechanics and structures, chemistry, mathematical and computer sciences, electronics, materials, fluid mechanics, propulsion, atmospheric sciences, space sciences, biological sciences, and human performance. All projects are coordinated through the Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds across the Department of Defense. All technology areas are subject to long-range research planning and technical review by tri-Service scientific planning groups. Note: Congress added $2.0 million for the Center for Adaptive Optics and $3.0 million for Coal-Derived Jet Fuel in FY 1999. Congress added $3.8 million for the Center for Adaptive Optics and $3.0 million for Coal-Derived Jet Fuel, and earmarked $0.6 million of appropriated funds in FY 2000.

(U) B. Budget Activity Justification

This program is Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the Air Force invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.

(U) C. Program Change Summary ($ in Thousands)

		FY 1999	FY 2000	FY 2001	Total Cost
(U)	Previous President's Budget (FY 2000 PBR)	209,731	209,505	177,513	
(U)	Appropriated Value	210,395	216,305		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-664	-2		
	b. Small Business Innovative Research	-5,524			
	c. Omnibus or Other Above Threshold Reprogram		-1,124		
	d. Below Threshold Reprogram	-5,594			
	e. Rescissions	-1,106	-1,357		
	f. Other				
(U)	Adjustments to Budget Years Since FY 2000 PBR			28,636	
(U)	Current Budget Submit/FY 2001 PBR	197,507	213,822	206,149	TBD

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	February 2000
BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences

(U) C. Program Change Summary ($ in Thousands) Continued

(U) Significant Program Changes:

Changes to this program since the previous President's Budget are due to a joint re-evaluation of priorities by the Air Force and the Office of the Secretary of Defense.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612301

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612301 Physics	21,401	25,690	22,038	21,952	21,964	22,126	22,700	Continuing	TBD

(U) A. Mission Description

Physics research provides the fundamental understanding to improve technologies critical to Air Force lasers, avionics, and microwaves. The research enables improvements in electromagnetic countermeasures, protection against nuclear weapons effects, communications, small satellites, and non-destructive, and non-intrusive testing and analysis. It also supports the development of new sensors. The primary areas of research investigated by this project are laser and optical physics; atomic, molecular, and imaging physics; and plasma physics.

(U) FY 1999 ($ in Thousands)

(U) $7,082 Performed research in laser and optical physics for aerospace applications, and optical devices for spoofing and damaging infrared seeking missiles, countermeasures, and directed energy weapons devices. Directed studies toward developing optimum lasers for high image quality telescopes for space surveillance. Examined the physics of lethal and non-lethal directed energy for speed-of-light target kill.

(U) $6,315 Studied atomic, molecular, and imaging physics to enhance space surveillance capabilities in the area of target detection and recognition. Developed advanced atomic molecular processes to produce ideal performance time standards.

(U) $5,867 Conducted plasma physics research for future directed energy weapons, affordable low-observables, and space communications and surveillance. Advanced state-of-the-art in explosive-driven power generators. Examined the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy weapon threats.

(U) $2,137 Performed research in adaptive optics for application in advanced ground-based telescopes.

(U) $21,401 Total

(U) FY 2000 ($ in Thousands)

(U) $9,801 Perform laser and optical physics research for new laser devices and controls to make possible spoofing and fatal damage of infrared-seeking missiles, improve high performance radars, and enable new directed energy weapons. Investigate the physics of semiconductor and solid state lasers and laser arrays through experiments and system modeling to advance laser technology. Study a new high-power laser to replace oxygen-iodine for the next generation of the airborne laser. Examine pico-second and femto-second (extremely fast) lasers for generation and control of millimeter waves and wideband optical modulation to enhance high-performance radars. Evaluate micro-electro-mechanical systems (MEMS) to enable specialized devices for micro-satellite applications.

(U) $7,533 Conduct research in plasma physics to investigate fundamental atomic and molecular interactions for future directed-energy weapons, affordable low-observables, and space communications and surveillance. Examine the controlled resistive, dielectric, and conducting behavior of plasmas

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BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612301

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

and the effects of plasmas on transmission, reflection, and absorption of electromagnetic waves to enable novel stealth aircraft mechanisms.

(U) $4,556 Study atomic, molecular, and imaging physics to evaluate the interaction of atoms, molecules, and ions to provide basic information for use in improved explosives and fuels, enhanced space surveillance, superior communications, and precision navigation. Identify interactions of atoms in strong fields to discover novel lasers for Air Force applications. Examine isomeric, high density energy storage for flash radiation devices and to make long flight missions possible without refueling.

(U) $3,800 Continue research on adaptive optics to study phenomena and devices associated with guide star adaptive optical telescopes for laser beam projection into space, and deep space surveillance and identification.

(U) $25,690 Total

(U) FY 2001 ($ in Thousands)

(U) $10,002 Perform laser and optical physics research for new laser devices and controls to make possible spoofing and fatal damage of infrared-seeking missiles, improve high performance radars, and enable new directed energy weapons. Continue to investigate semiconductor and solid state lasers and laser arrays through experiments and system modeling to advance laser technology. Investigate a new high-power laser to replace oxygen-iodine for the next generation of the airborne laser. Examine pico-second and femto-second (extremely fast) lasers for generation and control of millimeter waves and wideband optical modulation to enhance high-performance radars. Expand studies of micro-electro-mechanical systems (MEMS) and laser photochemical processes to enable specialized devices for micro-satellite applications.

(U) $7,713 Conduct research in plasma physics to investigate fundamental atomic and molecular interactions for future directed-energy weapons, affordable low-observables, and space communications and surveillance. Explore physics issues relating to plasma processing of materials at atmospheric pressures to contribute to higher frequency, more efficient, high power microwave systems. Examine the controlled resistive, dielectric, and conducting behavior of plasmas, and the effects of plasmas on transmission, reflection, and absorption of electromagnetic waves to enable novel stealth aircraft mechanisms. Investigate the feasibility of using collisional ionized gas volumes to protect friendly assets from directed energy.

(U) $4,323 Study atomic, molecular, and imaging physics to evaluate the interaction of atoms, molecules, and ions to provide basic information for use in improved explosives and fuels, enhanced space surveillance, superior communications, precision navigation, and the neutralization of biological threats. Investigate the trapping and cooling of atoms and ions to enrich high-resolution spectroscopy. Characterize interactions of atoms in strong fields to discover novel lasers for Air Force applications. Continue to examine isomeric, very high density energy storage for flash radiation devices and to make long flight missions possible without refueling.

(U) $22,038 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE
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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	612301

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602601F, Space Technology.
(U) PE 0602204F, Aerospace Sensors.
(U) PE 0602605F, Directed Energy Technology.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612302

COST ($ in Thousands)		FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612302	Solid Mechanics and Structures	17,325	15,907	11,489	11,258	11,157	10,872	10,457	Continuing	TBD

(U) A. Mission Description

Solid Mechanics and Structures basic research aims to drastically improve the behavior of aerospace materials and structures by better describing how they wear and are damaged. It also expands fundamental knowledge of the aero-elastic and acoustic behavior of airframes and engine structures, and the dynamic behavior of launch vehicles and space structures. The goal is the cost-effective development, and safe, reliable operation of superior Air Force weapons and defensive systems. Research topics include: the design of advanced material structures on a micro scale; modeling and simulation of the dynamic behavior of aircraft, missiles, and large space structures; and technology integration for the performance and survivability enhancement of these systems. The primary areas of research investigated by this project are mechanics of composite materials, structural mechanics and dynamics, and shock physics.

(U) FY 1999 ($ in Thousands)

(U) $6,375 Studied thermomechanical behavior of advanced structural materials, including micromechanics of high-temperature composite materials for aerospace structural systems and coatings. Investigated the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.

(U) $5,850 Modeled materials for aerospace structures, including dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems. Developed fundamental understanding of the behavior of aeroelastic structures and conducted research into the behavior of actuator/structure interaction for control of shell-structures in vibro/acoustic environments.

(U) $5,100 Sought fundamental particulate mechanics knowledge, including quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems. Investigated the fundamental relationship of geomaterials undergoing high strain rate loadings with increased confining pressures as occurs when facilities are impacted by penetrating weapons.

(U) $17,325 Total

(U) FY 2000 ($ in Thousands)

(U) $3,339 Study mechanics of composite materials to investigate new structural concepts and the underpinning mechanics principles that will enable revolutionary improvements in design and capability of air and space weapon systems. Examine the fundamental behavior of dynamic systems to enable the development of efficient computational techniques and design methodologies for turbine engines, air vehicles, launch systems, and orbital weapon systems. Seek fundamental knowledge on potential air vehicle components, including metallic and inter-metallic alloys, and solid rocket propellants and liners to enhance air and space vehicle performance and longevity.

(U) $10,240 Expand structural mechanics research to examine innovative adaptive structure concepts for deployment of space-based systems and

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BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612302

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

multi-mission uninhabited air vehicles. Evaluate the behavior of distributed sensor and actuator systems to achieve major improvements in the design and performance prediction of aerospace weapon systems. Identify system techniques to analyze vehicle integrity and achieve major increases in structural longevity of Air Force weapon systems.

(U) $2,328 Perform dynamics and shock physics research to identify the fundamental damage mechanisms in structural materials in order to model and predict effects of weapon impacts and assess damage of penetrating munitions. Devise fundamental mechanics principles and life-span prediction methodologies to significantly enhance design and life cycle management methodologies of Air Force weapon systems.

(U) $15,907 Total

(U) FY 2001 ($ in Thousands)

(U) $2,410 Study mechanics of composite materials to investigate new structural concepts and the underpinning mechanics principles that will enable revolutionary improvements in capability and design of air and space weapon systems. Continue to explore the fundamental behavior of dynamic systems and develop efficient computational techniques and design methodologies for turbine engines, air vehicles, launch systems, and orbital weapon systems. Continue efforts to seek fundamental knowledge on air vehicle components, including metallic and inter-metallic alloys, advanced composite materials, and solid rocket propellants and liners to enhance air and space vehicle performance and longevity.

(U) $7,399 Conduct structural mechanics research to examine innovative adaptive structure concepts for deployment of space-based systems and multi-mission uninhabited air vehicles. Evaluate the behavior of distributed sensor and actuator systems to improve the design and performance prediction of aerospace systems. Identify fundamental structural design characteristics underpinning the life cycle of airframe structures. Develop system techniques to analyze vehicle integrity and significantly increase the structural longevity of Air Force weapon systems.

(U) $1,680 Perform dynamics and shock physics research to identify the fundamental damage mechanisms in structural materials to model and predict effects of weapon impacts and assess damage of penetrating munitions. Devise fundamental mechanics principles and life-span prediction methodologies to significantly enhance design and life cycle management methodologies of Air Force weapon systems. Investigate the mechanical and dynamic behavior of micro-scale structures leading to exceptional capabilities in micro-electro-mechanical systems (MEMS).

(U) $11,489 Total

(U) B. Project Change Summary

Not Applicable.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	612302

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602102F, Materials.
(U) PE 0602201F, Aerospace Flight Dynamics.
(U) PE 0602202F, Human Effectiveness Applied Research.
(U) PE 0603211F, Aerospace Structures.
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602269F, Hypersonic Technology Program.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612303

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612303 Chemistry	24,304	27,215	26,735	26,681	26,693	26,635	27,421	Continuing	TBD

(U) A. Mission Description

Chemistry research seeks bold innovation in understanding and controlling chemical reactions to develop new materials, improve synthesis of existing materials, control energy flow and storage, and control the interaction between materials and their environments. Studies address chemical dynamics and energy transfer processes that foster advances in laser weaponry, allow predicting infrared, optical and radar signatures, and enable the synthesis of new chemical propellants. Critical research topics include novel synthesis and characterization of lower cost and higher performance functional and structural materials, electronic and photonic materials, nano-structures, electromagnetic and conventional weaponry, and propellants. Focused investigations include the effects of chemical and morphological structures on functional and mechanical properties of polymeric materials, and the exploration of atomic and molecular surface interactions that limit performance of electronic devices, compact power sources, and lubricant materials. The primary areas of research are molecular dynamics and theoretical chemistry, polymer chemistry, and surface science.

(U) FY 1999 ($ in Thousands)

(U) $10,254 Investigated impact of emissions from solid rocket motor exhaust on the atmosphere. Studied rates of reactions of ions with fuel constituents to enable ways to improve high-speed propulsion. Developed and synthesized novel energetic compounds for application as high energy density rocket propellants. Investigated new approaches for generating novel chemical laser systems.

(U) $7,262 Achieved large electro-optical coefficient polymers for highly efficient radio frequency (RF) link applications. Investigated charge-trapping mechanism in photorefractive polymers to improve their response speed. Investigated nanostructures for photonic bandgap applications. Improved impact toughness of polymers based on nanophase separation control.

(U) $6,788 Developed an atomistic model for aircraft aluminum corrosion. Synthesized and evaluated an advanced vapor lubricant for operations in the extreme temperature environments of high performance turbine engines. Developed a new nanolithographic method for generation of novel surface nanostructures. Conducted research on unique energy-dense materials for compact power systems.

(U) $24,304 Total

(U) FY 2000 ($ in Thousands)

(U) $12,037 Perform molecular dynamics and theoretical chemistry research to identify and predict techniques to control molecular reactivity and energy flow and to develop predictive tools for designing new materials and processes for advanced propellants and high-energy lasers. Devise methods for predicting molecular-level energy transfer and chemical reactivity to simulate signatures and interactions of aerospace vehicles in extreme environments. Seek fundamental knowledge to formulate new high energy density materials for rocket propellants.

(U) $9,144 Conduct polymer chemistry research to improve fundamental understanding of chemical structures and processing conditions to develop

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BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612303

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

advanced polymeric materials that significantly improve aircraft and spacecraft performance and life-spans. Evaluate spectral sensitivity of photo refractive polymers for crucial infrared applications. Investigate polymer coatings to enable advanced sensors applications. Develop fundamental knowledge to formulate materials that have suitable optical transitions for highly efficient optical limiting properties to enable flexible communications in space operations. Evaluate high temperature nanocomposite polymers for superior space propulsion.

(U) $6,034 Study surface science to investigate the chemistry of surface processes for accurate detection and prevention of corrosion and degradation of air and space systems, and formulation of novel lubricants. Investigate surface chemical processes and structures to enhance performance, reduce maintenance, and increase the longevity of air and space systems. Explore the reactions and mechanisms for protection of aluminum aircraft from corrosion. Investigate novel three-dimensional surface nano-structures for sensor, optical, and power applications.

(U) $27,215 Total

(U) FY 2001 ($ in Thousands)

(U) $11,825 Perform molecular dynamics and theoretical chemistry research to identify and predict techniques to control molecular reactivity and energy flow, and to develop predictive tools for designing new materials and processes for advanced propellants and high-energy lasers. Evaluate methods for predicting molecular-level energy transfer and chemical reactivity to simulate signatures and interactions of aerospace vehicles in extreme environments. Examine the use of molecular nano-clusters for use as catalysts and sensors. Develop new high energy density materials for rocket propellants and novel chemical laser systems.

(U) $8,982 Conduct polymer chemistry research to improve fundamental understanding of chemical structures and processing conditions to develop advanced polymeric materials for significantly improved aircraft and spacecraft performance and life-spans. Improve spectral sensitivity of photo refractive polymers for crucial infrared applications. Investigate polymer coatings to enable smart skins and advanced sensors for air and space weapon systems. Evaluate the stability of functional polymers in space environments to enhance survivability of vehicles exposed to space radiation. Continue to seek fundamental knowledge to formulate materials that have suitable optical transitions for highly efficient optical limiting properties.

(U) $5,928 Study surface science to investigate the chemistry of surface processes for accurate detection and prevention of corrosion and degradation of air and space systems, and formulation of novel lubricants. Continue investigation of surface chemical processes and structures to enhance performance, reduce maintenance, and increase the longevity of air and space systems. Develop predictive and experimental models for molecular lubrication in high-temperature, high-wear environments. Explore the reactions and mechanisms for protection of aluminum aircraft from corrosion. Examine surface structures with enhanced energy-densities for significantly improved weapon system energy storage and delivery.

(U) $26,735 Total

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	612303

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0602601F, Space Technology.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612304

COST ($ in Thousands)		FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612304	Mathematical and Computer Sciences	32,388	32,557	33,153	32,683	32,237	31,590	30,971	Continuing	TBD

(U) A. Mission Description

Mathematics research expands techniques for mathematical modeling, simulation, and control of complex systems, and develops innovative analytical and computational methods for aerospace systems. Research provides improved performance and control of aerospace systems through accurate models and computational tools, artificial intelligence, and improved programming techniques and theories. The primary areas of research investigated by this project are dynamics and control, physical mathematics and applied analysis, computational mathematics, optimization and discrete mathematics, signals communication and surveillance, systems and software, and external aerodynamics and hypersonics.

(U) FY 1999 ($ in Thousands)

(U) $11,661 Performed research on computer software and systems for battlespace information management. Expanded research in transportable agent technology to support defensive information warfare applications and real-time problem solving strategies to support dynamic planning and execution.

(U) $11,010 Studied physical mathematics, control and signal processing, and modeled advanced materials including composites and smart skins in support of the Air Force's New World Vistas (NWV) programs. Developed modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engines, aerodynamics, and combustor instabilities. Created modeling and control algorithms for adaptive optics to handle extreme atmospheric turbulence encountered in target acquisition on systems such as the Airborne Laser.

(U) $9,717 Investigated computational science for improved design and simulation of advanced aerospace systems. Integrated new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines, aircraft wings, and other aerospace components. Developed algorithms incorporating active control procedures.

(U) $32,388 Total

(U) FY 2000 ($ in Thousands)

(U) $6,707 Perform dynamics and control research to develop new techniques for design and analysis of control systems to significantly enhance capabilities and performance of aerospace vehicles. Develop modeling, identification, and control capabilities necessary for the integrated control of vehicle aerodynamics and jet engine performance. Create control algorithms for optical components to handle extreme atmospheric turbulence encountered in target acquisition on deployable laser platforms. Formulate algorithms incorporating active control procedures to provide more efficient flow through jet engines.

(U) $6,679 Conduct computational systems, software, artificial intelligence, and software reliability research to investigate unique computer technologies to

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

devise critical software and computational systems for battlespace information management. Expand automatic large knowledge base construction from multiple, variant sources and automatic knowledge acquisition to enhance Air Force intelligence operations. Formulate distributed, automatic resource management approaches for new methods of mobile agent resource allocation and protection.

(U) $6,562 Conduct physical mathematics and applied analysis, and electromagnetics research to devise accurate models of physical phenomena to enhance controls and signal processing techniques. Predict nonlinear optical effects within semiconductor lasers and through other nonlinear optical media for applications in laser beam control and stability. Model detonation shock dynamics to support reconfigurable conventional warhead design. Identify optimal electromagnetic wave propagation/scattering codes to provide accurate and timely target recognition. Refine physical mathematics, control and signal processing techniques, and model advanced electromagnetic materials, composites, and smart skins for air and space weapons.

(U) $4,748 Study optimization and discrete mathematics to devise advanced mathematical methods for solving complex problems in logistics, engineering design, and strategic planning for battlespace information management. Expand transportable agent technology to support defensive information warfare applications. Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines, aircraft wings, and other aerospace components.

(U) $3,548 Perform computational mathematics research to devise unique simulations and designs of advanced Air Force systems. Integrate new multidisciplinary design optimization strategies with high-order, time-accurate solvers for superior design of jet engines, aircraft wings, and other aerospace components. Invent methods to reduce computation time for chemical laser simulations. Identify failure modes of bonded composite materials by inserting novel computational methods into mission-support software tools.

(U) $2,649 Study signals communication and surveillance to expand quantitative methodologies that extend the capability of critical mobile, wireless, and networked communications systems, and strengthens performance of surveillance and targeting functions through autonomous and human-assisted sensing/response platforms. Analyze irreducible expansions of signals, soft threshholding, and efficient source-channel coding in wireless communication to improve cost versus performance trade offs.

(U) $1,664 Perform external aerodynamics and hypersonics research to develop fundamental knowledge of basic fluid dynamics and plasma-aerodynamics to predict and control supersonic and hypersonic flows over combat maneuvering flight vehicle systems. Devise accurate flow solvers for optimal design of aircraft wings and novel aerospace components.

(U) $32,557 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612304

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$6,828	Perform dynamics and control research to develop new techniques for design and analysis of control systems to significantly enhance capabilities and performance of aerospace vehicles. Develop modeling, identification, and control capabilities necessary for the integrated control of vehicle aerodynamics and engine performance. Continue creating control algorithms for optical components to handle extreme atmospheric turbulence encountered in target acquisition on deployable laser platforms. Expand active and adaptive control algorithms to enable autonomous air, space, and ground operations.
(U)	$6,800	Conduct computational systems, software, artificial intelligence, and software reliability research to investigate unique computer technologies to devise critical software and computational systems for battlespace information management. Continue automatic large knowledge base construction from multiple, variant sources and automatic knowledge acquisition to enhance Air Force intelligence operations. Refine distributed, automatic resource management approaches for advanced methods of mobile agent resource allocation and protection.
(U)	$6,682	Conduct physical mathematics and applied analysis, and electromagnetics research to devise accurate models of physical phenomena to enhance controls and signal processing techniques. Investigate the feasibility of coherently propagating short laser pulses through the air for superior accuracy in laser guided munitions. Predict nonlinear optical effects within semiconductor lasers and through other nonlinear optical media for applications in laser beam control and stability. Formulate optimal electromagnetic wave propagation/scattering codes to provide accurate and timely target recognition. Evaluate methods to penetrate tree cover and recognize targets.
(U)	$4,834	Study optimization and discrete mathematics to devise advanced mathematical methods for solving complex problems in logistics, engineering design, and strategic planning for battlespace information management. Expand transportable agent technology to support defensive information warfare applications and formulate real-time problem solving strategies to support dynamic planning and execution.
(U)	$3,612	Perform computational mathematics research to devise unique simulations and designs of advanced Air Force systems. Continue integrating new multidisciplinary design optimization strategies with high-order, time-accurate solvers for superior design of jet engines, aircraft wings, and other aerospace components. Devise methods to reduce computation time for chemical laser simulations from months to days. Investigate failure modes of bonded composite materials by inserting novel computational methods into mission support software tools.
(U)	$2,698	Study signals communication and surveillance to expand quantitative methodologies that extend the capability of critical mobile, wireless, and networked communications systems, and strengthens performance of surveillance and targeting functions through autonomous and human-assisted sensing/response platforms. Investigate irreducible expansions of signals, soft threshholding, and efficient source-channel coding in wireless communication to achieve major improvements in cost versus performance trade offs. Expand probabilistic process theory, functional analysis techniques, and information theory to eliminate current limits of sensing and communication system performance.
(U)	$1,699	Perform external aerodynamics and hypersonics research to develop fundamental knowledge of basic fluid dynamics and plasma-aerodynamics to predict and control supersonic and hypersonic flows over combat maneuvering flight vehicle systems. Devise accurate flow solvers for

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

optimal design of aircraft wings and novel aerospace components. Refine plasma-aerodynamic optimization techniques to enable design of superior scramjet engines.

(U) $33,153 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602201F, Aerospace Flight Dynamics.
(U) PE 0602702F, Command, Control, and Communications
(U) PE 0603789F, C3I Advanced Development.
(U) PE 0602269F, Hypersonic Technology Program.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612305

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612305 Electronics	22,021	24,144	24,246	24,082	23,710	23,247	22,728	Continuing	TBD

(U) A. Mission Description

Electronics research builds a fundamental understanding of electronic materials, devices, and systems to advance Air Force operational capabilities in directed energy weapons, stealth technologies, electronic countermeasures, information and signal processing, and communications. The focus is on developing electronic processes to model and predict performance of electronic materials, devices, and systems for power generation, optical signal processing, radiation effects, and high-speed signal processing. The goals are to firmly control the complexity and reliability of electronic systems, increase data transmission and information processing speeds of Air Force systems, and improve the security and reliability of electronic information. The primary areas of research investigated by this project are space electronics, optoelectronic materials, optoelectronic information processing, and quantum electronic solids.

(U) FY 1999 ($ in Thousands)

(U) $11,867 Studied semiconductor electronic materials, advanced devices, interface control, and stability for improved laser and detector applications. Investigated methods to electronically tailor compound semiconductors and examined high-temperature electronics for use in hostile environments.

(U) $6,340 Sought fundamental understanding of optoelectronic information processing and storage. Investigated advanced communications, signal processing, and computing; and examined novel micro-lasers and ultra-high density information storage and retrieval.

(U) $3,814 Investigated superconducting and nanoscopic materials, devices, and applications for advanced communications and higher speed signal processing and denser memory. Created high current, high temperature, superconducting materials for power generation and storage on space platforms.

(U) $22,021 Total

(U) FY 2000 ($ in Thousands)

(U) $7,886 Perform space electronics research to examine military unique low-power and complementary electronic circuits to greatly reduce the size and weight of space platforms. Characterize surface and interface states to prevent electronic device degradation in Air Force systems. Explore wide bandgap semiconductor materials ideal for radio frequency power sources and high-temperature operations for air and space weapon systems.

(U) $7,798 Conduct optoelectronic materials research to investigate detection of optical radiation from far infrared to the ultraviolet spectral range to achieve surveillance dominance of the battlespace. Invent unique materials to protect critical optical systems from enemy attack. Devise laser materials to detect, degrade, or blind an adversary's detection capabilities. Create models of new detectors for characterization of the battlespace and surveillance.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612305

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

(U)	$4,590	Study optoelectronic information processing to explore development and application of optoelectronic materials and devices to enhance critical communication system accuracy, speed, and data storage. Formulate high bandwidth, multi-wavelength modulators and detectors for Air Force imaging and communication systems. Create optical materials for high-bandwidth communication and parallel signal processing for enabling the increased data transfer speeds required for military operations.
(U)	$3,870	Perform quantum electronic solids research to investigate superconducting, magnetic and nanoscopic materials and devices for advanced sensing communications and signal processing, and superior data storage capabilities. Create high-current, high-temperature superconducting tapes and cables for enhanced power generation and storage on Air Force space platforms. Investigate measurement of corrosion in aircraft structures to extend performance life span.
(U)	$24,144	Total

(U) FY 2001 ($ in Thousands)

(U)	$7,920	Perform space electronics research to examine military unique low-power and complementary electronic circuits to greatly reduce the size and weight of space platforms. Continue characterizing surface and interface states to prevent electronic device degradation. Explore wide bandgap semiconductor materials ideal for radio frequency power sources and high-temperature operations. Identify fundamental radiation effects on electronic and semiconductor materials and devise methods to prevent space system degradation or destruction.
(U)	$7,831	Conduct optoelectronic materials research to investigate detection of optical radiation from far infrared to the ultraviolet spectral range to achieve surveillance dominance of the battlespace. Invent unique materials to protect critical optical systems from enemy attack. Devise laser materials to detect, degrade, or blind an adversary's detection capabilities. Create new detectors for characterization of the battlespace, surveillance, and to obtain target signatures in spectral ranges appropriate for quick target recognition.
(U)	$4,609	Study optoelectronic information processing to explore development and application of optoelectronic materials and devices to enhance critical communication system accuracy, speed, and data storage. Investigate high bandwidth, multi-wavelength modulators and detectors to refine complex semiconductor structures for imaging and communication systems. Create optical materials for maximum high-bandwidth communication and parallel signal processing for enabling secure satellite communications and the increased data transfer speeds required for military operations.
(U)	$3,886	Perform quantum electronic solids research to investigate superconducting, magnetic and nanoscopic materials and devices for advanced sensing communications and signal processing, and superior data storage capabilities. Create high-current, high-temperature superconducting tapes and cables for enhanced power generation and storage on Air Force space platforms and directed energy weapons. Formulate innovative approaches to measure active corrosion in aircraft structures to extend performance lifespan.
(U)	$24,246	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE
	February 2000

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	612305

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602204F, Aerospace Sensors.

(U) PE 0602702F, Command, Control, and Communications.

(U) PE 0603789F, C3I Advanced Development.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612306

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612306 Materials	11,407	13,102	14,082	14,200	14,246	14,378	14,920	Continuing	TBD

(U) A. Mission Description

Materials research enhances the performance, cost, and reliability of structural materials to eliminate material reliability issues related to high-temperature strength, toughness, fatigue, and environmental conditions. Examination of material strength, toughness, fatigue resistance, and corrosion resistance will enable novel materials for airframe, turbine engine, and spacecraft structures. Emphasis is on refractory alloys, inter-metallics, polymer composites, metal and ceramic matrix composites, and advanced ceramics, such as alumina, silicon carbide, silicon nitride, and carbon/carbon. Research seeks to develop improved aerospace vehicle structural materials, increase the operating temperature of engine materials which will further increase thrust-to-weight ratio of engines. Research in new processing methods complements research on materials properties. The primary areas investigated by this project are ceramic and non-metallic materials, metallic materials, and organic matrix composites.

(U) FY 1999 ($ in Thousands)

(U) $6,165 Performed fundamental studies of very-high temperature, non-metallic materials for airbreathing engine, space vehicle, and rocket propulsion applications. Investigated coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications, and ultra-high temperature materials systems based on carbides for rocket propulsion applications.

(U) $4,107 Performed research on metallic systems for engines and airframe applications. Studied thermal and mechanical stability of refractory metal systems for very-high temperature applications, and investigated functionally gradient structures for thermal barrier coatings.

(U) $1,135 Studied life and reliability of polymeric composites by researching non-destructive evaluation techniques on adhesive-bonded structures. Investigated free-volume effects in controlling moisture absorption mechanisms and rates in polymer matrix composites.

(U) $11,407 Total

(U) FY 2000 ($ in Thousands)

(U) $4,261 Perform ceramic and non-metallic materials research to examine the fundamentals of very-high temperature, non-metallic materials for airbreathing and rocket engines, and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for jet engine blade applications.

(U) $6,936 Conduct metallic materials research to evaluate novel metallic systems for engines and airframe applications. Expand investigations of thermal and mechanical stability of refractory metal systems for very-high temperature aircraft applications. Identify functionally gradient structures for superior thermal barrier coatings.

(U) $1,905 Study organic matrix composites to expand knowledge of polymer matrix composites for increasing the strength and life-span of air and space

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612306

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

vehicle structures. Explore novel ring-opening chemistry to develop resins with controlled volume shrinkage to improve mechanical properties of high performance adhesives and matrix resins. Investigate moisture degradation of mechanical and electromagnetic properties in glass fiber reinforced composite structures.

(U) $13,102 Total

(U) FY 2001 ($ in Thousands)

(U) $4,579 Perform ceramic and non-metallic materials research to examine the fundamentals of very-high temperature, non-metallic materials for airbreathing and rocket engines, and space vehicle applications. Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for jet engine blade applications. Seek fundamental knowledge to formulate ultra-high temperature materials systems based on carbides for rocket propulsion applications.

(U) $7,454 Conduct metallic materials research evaluates novel metallic systems for engines and airframe applications. Explore thermal and mechanical stability of refractory metal systems for very-high temperature aircraft applications. Evaluate functionally gradient structures for superior thermal barrier coatings.

(U) $2,049 Study organic matrix composites to expand knowledge of polymer matrix composites to increase the strength and life-span of air and space vehicle structures. Explore thermal cycling effects of polymer matrix composites down to cryogenic temperature range to better understand durability issues in liquid fuel tank environments. Investigate innovative fiber sizing techniques to minimize moisture degradation of mechanical and electromagnetic properties in glass fiber reinforced composite structures.

(U) $14,082 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602102F, Materials
(U) PE 0603211F, Aerospace Structures.
(U) PE 0708011F, Industrial Preparedness.
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602201F, Aerospace Flight Dynamics.
(U) PE 0602269F, Hypersonic Technology Program.

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BUDGET ACTIVITY: 01 - Basic Research	PE NUMBER AND TITLE: 0601102F Defense Research Sciences
PROJECT: 612306	

(U) C. Other Program Funding Summary ($ in Thousands)

(U) PE 0602601F, Space Technology.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612307

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612307 Fluid Mechanics	6,766	9,858	9,712	9,769	9,886	10,103	10,616	Continuing	TBD

(U) A. Mission Description

Fluid Mechanics research advances fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of aerospace vehicles. Understanding of key fluid flow (primarily high-speed air) phenomena is directed to improve theoretical models for aerodynamic prediction and design, and to originate flow control concepts and predictive methods to expand current flight performance boundaries. The emphasis is on turbulence prediction and control, unsteady and separated flows, hypersonics, and internal fluid dynamics. The primary approach is to formulate advanced computational methods to: simulate and study complex flows; predict real gas effects in high-speed flight; and control and predict turbulence in flight vehicles and propulsion systems. The primary areas of research investigated by this project are unsteady aerodynamics, hypersonic aerodynamics, turbulence and flow control, and rotating flows.

(U) FY 1999 ($ in Thousands)

(U) $1,556 Conducted external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems. Developed fluid/structural interaction models based on flow field interaction research. Investigated novel concepts for hypersonic flow control to reduce the size and weight of new hypersonic air vehicles.

(U) $3,231 Performed turbulence and flow control research to enhance air vehicle stability, performance, and control. Developed micro-electromechanical systems (MEMS) actuators and sensors for micro-air vehicle systems, and investigated the use of MEMS devices on swept wing air vehicles.

(U) $1,979 Conducted internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems. Developed MEMS devices for turbine engine control and Large Eddy Simulation (LES) methodology for turbomachinery flows.

(U) $6,766 Total

(U) FY 2000 ($ in Thousands)

(U) $2,957 Perform unsteady aerodynamics research to provide fundamental knowledge of high-speed air flow to optimize current Air Force air vehicle designs, and enable revolutionary future weapon systems. Investigate unsteady, complex, three-dimensional flows to refine the control and flight performance of unmanned air vehicles. Devise flow control design tools used to minimize flow separation and air vehicle drag. Develop fluid/structural interaction design tools to predict vehicle failure modes in rapid maneuvers.

(U) $2,465 Conduct hypersonic aerodynamics research to investigate complex flowfield phenomena for enabling the design of future Air Force trans-atmospheric vehicles and their flight control systems. Formulate concepts for hypersonic flow control, including plasma and magneto-hydrodynamic techniques to enable new high-speed weapon systems. Develop high-speed flow prediction codes to quantify thermal stresses in high performance air and space weapon systems.

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BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612307

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

(U)	$2,464	Seek fundamental knowledge of turbulence and flow control to enhance the performance, controllability, and stability in high performance air vehicles. Create novel micro-electromechanical systems (MEMS) actuators, and investigate actuation coupling mechanisms in turbulent flows to enable agile flight vehicles with significantly reduced power requirements. Evaluate the use of MEMS devices for flow control on swept wing air vehicles to substantially reduce drag.
(U)	$1,972	Study rotating flows to evaluate internal flow characteristics for enabling significant enhancement of performance and reliability/ maintainability of airbreathing propulsion systems. Invent promising MEMS devices for turbine engine control and Large Eddy Simulation methodology for affordable, high fidelity predictions of gas turbine engine flow fields.
(U)	$9,858	Total

(U) FY 2001 ($ in Thousands)

(U)	$2,428	Perform unsteady aerodynamics research to provide fundamental knowledge of high-speed air flows to optimize current Air Force air vehicle designs, and enable revolutionary future weapon systems. Investigate unsteady, complex, three-dimensional flows to refine the control and flight performance of unmanned air vehicles. Continue to devise design tools for flow control to minimize flow separation and air vehicle drag. Continue to develop fluid/structural interaction design tools to predict vehicle failure modes in rapid maneuvers.
(U)	$2,913	Conduct hypersonic aerodynamics research to investigate complex flowfield phenomena for enabling the design of future Air Force trans-atmospheric vehicles and their flight control systems. Advance concepts for hypersonic flow control, including plasma and magneto-hydrodynamic techniques. Develop high-speed flow prediction codes to quantify thermal stresses.
(U)	$2,429	Seek fundamental knowledge of turbulence and flow control to enhance the performance, controllability, and stability in air vehicles. Evaluate novel MEMS actuators, and investigate actuation coupling mechanisms in turbulent flows to enable agile flight vehicles with significantly reduced power requirements. Evaluate the use of MEMS devices for flow control on swept wing air vehicles with a goal of substantial drag reduction.
(U)	$1,942	Study rotating flows to evaluate internal flow characteristics for enhancing the performance and reliability/maintainability of air-breathing propulsion systems. Evaluate promising MEMS devices for turbine engine control and Large Eddy Simulation methodology for affordable high fidelity predictions of gas turbine engine flow fields and heat transfer effects.
(U)	$9,712	Total

(U) B. Project Change Summary

Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE
	February 2000

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	612307

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602201F, Aerospace Flight Dynamics.

(U) PE 0603211F, Aerospace Structures.

(U) PE 0602269F, Hypersonic Technology Program.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612308

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612308 Propulsion	13,766	20,027	18,648	18,486	18,390	18,413	18,540	Continuing	TBD

(U) A. Mission Description

Propulsion research seeks the efficient utilization of energy in airbreathing engines, chemical and non-chemical rockets, and combined cycle propulsion systems for access to space. Research thrusts include airbreathing propulsion, space power and propulsion, high altitude signature characterization and contamination, propulsion diagnostics, and thermal management of space-based power and propulsion systems. Chemically reacting flow and non-chemical energetics are investigated. Study of chemically reacting flows involves the complex coupling between energy release through chemical reaction and the flow processes that transport chemical reactants, products, and energy. Non-chemical energetic systems include plasma and beamed energy propulsion for orbit raising space missions, and efficient ultra-high energy techniques for space-based energy utilization. The primary areas of research investigated by this project are space power and propulsion, combustion, and diagnostics.

(U) FY 1999 ($ in Thousands)

(U) $5,434 Performed research on space and rocket propulsion and power through the development of supercritical combustion models for rocket propulsion. Modeled predictions of mini-satellite propulsion and performance for high precision clusters of cooperating autonomous microsatellite operations. Performed experimental and numerical studies of high altitude ultraviolet (UV) and infrared (IR) signatures to protect space assets.

(U) $4,592 Studied airbreathing combustion for propulsion systems for hypersonic flight capability by examining combustion product formation in gas turbine engines, and explored very high temperature and pressure (supercritical) fuel behavior under high temperatures and pressure conditions. Studied the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines.

(U) $740 Investigated propulsion diagnostics of new propulsion system concepts through data reduction and interpretation approaches. Extended diode-laser spectroscopic technique for on-board control of propulsion system operation and performance.

(U) $3,000 Developed coal-derived jet fuels by investigating refinery processing techniques for coal processing with petroleum, additives to suppress fuel system fouling, combustion characteristics of candidate fuels, and fuel-material interactions.

(U) $13,766 Total

(U) FY 2000 ($ in Thousands)

(U) $6,657 Perform research on space power and propulsion to investigate novel propulsion mechanisms to enable superior satellite propulsion performance. Model satellite propulsion characteristics for high-precision clusters of cooperating autonomous micro-satellites. Examine self-consuming satellites to increase payload and thrust capabilities. Create new concepts, such as pulsed detonation rocket and hybrid rocket engines, for optimal rocket propulsion. Identify experimental and numerical characteristics of high-altitude UV and IR and satellite

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612308

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

contamination to develop techniques to protect space assets.

(U) $6,222 Study combustion to evaluate airbreathing propulsion systems for hypersonic, supersonic, and subsonic flight to enhance air warfare capabilities. Develop computer models to increase weapon system efficiency by predicting unsteady behavior such as combustion instability. Examine the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines to increase thrust output and enable significantly advanced weapon systems.

(U) $4,148 Investigate advanced diagnostic systems for data reduction and interpretation to create concepts for novel propulsion system applications. Extend diode-laser spectroscopic technique for on-board control of propulsion system operation and performance.

(U) $3,000 Continue coal-derived jet fuels research to investigate refinery processing techniques for coal processing with petroleum, additives to suppress fuel system fouling, combustion characteristics of candidate fuels, and fuel-material interactions.

(U) $20,027 Total

(U) FY 2001 ($ in Thousands)

(U) $7,299 Perform space power and propulsion research to investigate novel propulsion mechanisms to enable superior satellite propulsion performance. Increase thrust and control of micro-satellite and nano-satellite propulsion systems to enable high-precision clusters of cooperating autonomous micro-satellites. Examine self-consuming satellites and mechanical-electric energy conversion to increase payload and thrust capabilities. Continue to develop new concepts, such as pulsed detonation, hybrid rockets and combined cycle engines, to enable very high temperature and pressure (supercritical) combustion for optimal rocket propulsion. Study experimental and numerical characteristics of high-altitude ultraviolet and infrared signatures and satellite contamination to develop techniques to protect space assets.

(U) $6,810 Study combustion to evaluate airbreathing propulsion systems for hypersonic, supersonic, and subsonic flight to enhance air warfare capabilities. Enhance computer models to increase efficiency by predicting unsteady behavior such as combustion instability. Examine primary and secondary atomization and mixing of fuels to optimize fuel injection to increase thrust output.

(U) $4,539 Investigate advanced diagnostics systems for data reduction and interpretation to create concepts for novel propulsion system applications. Obtain essential data through multiplexed diode-laser spectroscopy, enabling simultaneous detection of temperature and pressure within chemical propulsion systems to increase their thrust and efficiency.

(U) $18,648 Total

(U) B. Project Change Summary

Not Applicable.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	612308

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602601F, Space Technology.

(U) PE 0603211F, Aerospace Structures.

(U) PE 0602269F, Hypersonic Technology Program.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612310

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612310 Atmospheric Sciences	5,217	5,594	0	0	0	0	0	Continuing	TBD

(U) A. Mission Description

Upper Atmospheric research characterizes the Earth's upper atmosphere to predict and control its effects on Air Force tactical and strategic operations. The goal is to accurately model ionospheric irregularities and thermospheric dynamics to provide reliable, continuous communications, command, and control. Innovative techniques enable evaluation of the structure and chemistry of the mesosphere and thermosphere, and modeling of the physics and dynamics of the ionosphere to enhance global surveillance, geolocation, and communication capabilities. Focused investigations include observation and modeling of atmospheric tides and gravity waves, geomagnetic disturbances, auroral and airglow emissions, and plasma turbulence and dynamics. The primary areas of research investigated by this project are space weather, optical and auroral emission, and ionospheric scintillation and turbulence.

(U) FY 1999 ($ in Thousands)

(U) $1,603 Improved space weather specification and forecast models, and studied the coupling between the solar wind, the interplanetary magnetic field (IMF), and the earth's magnetosphere by using satellites to analyze the IMF and solar wind ions. Developed a Coordinated Community Modeling Center to bring researchers directly in touch with the DoD user community.

(U) $1,094 Analyzed atmospheric physics to understand and exploit the aerospace environment and improved atmospheric radiative transfer models to estimate the impacts of weather limitations on the employment of directed energy weapons. Investigated gravity wave interactions with ambient atmospheric vorticity fields that affect optical atmospheric emissions observed from orbit.

(U) $2,520 Studied ionospheric physics to enhance global surveillance capability and investigated ionosphere phenomena. Examined signatures of solar activity which disrupt global radio communications and space surveillance.

(U) $5,217 Total

(U) FY 2000 ($ in Thousands)

(U) $2,237 Perform space weather research to refine space phenomena prediction models to enable optimal design and protection of Air Force space assets. Develop satellite-based analysis techniques to examine the coupling between the solar wind, the interplanetary magnetic field, and the Earth's magnetosphere, and its effect on space operations. Support the space weather Coordinated Community Modeling Center, to transition information directly to the Air Force Space Forecast Center.

(U) $1,398 Conduct optical and auroral emission research to characterize the chemical and physical dynamics of the mesosphere, thermosphere, and ionosphere to develop a comprehensive map of regions that cause mission failure in space assets. Investigate atmospheric gravity wave interactions from high-latitude observation sites, using powerful new Light Detection and Ranging (LIDAR) techniques, to enable accurate

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BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612310

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

interpretation of optical emissions and refined modeling of the operational space environment.

(U) $1,959 Study ionospheric scintillation and turbulence to formulate prediction models to enhance global surveillance, geolocation, and communication capability. Investigate ionosphere plasma phenomena created by man-made radio waves, to enable active control of the operational space environment. Analyze and interpret signatures of solar activity to provide fundamantal knowledge to design techniques to prevent disruption of global radio communications, geolocation, and space surveillance.

(U) $5,594 Total

(U) FY 2001 ($ in Thousands)

(U) $0 Effort moved to Project 612311.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0305160F, Defense Meteorological Satellite Program.

(U) PE 0602601F, Space Technology.

(U) PE 0603220C, Surveillance, Acquisition, Tracking, and Kill.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612311

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612311 Space Sciences	6,404	8,524	14,894	14,786	14,768	14,866	15,054	Continuing	TBD

(U) A. Mission Description

Space Sciences research provides fundamental understanding of the space environment for optimum design of Air Force systems operating in near-Earth orbit and geosynchronous space. The goal is to enable protection of space assets from space debris, solar wind, solar flares, and geomagnetic storms. Focus is on specifying the flow of mass, momentum, and energy through space to develop a global model that connects solar activity with the deposition of energy at the Earth. Methods are developed to forecast the turbulent plasma phenomena that mediate the flow of energy through space, to enhance the effectiveness of Air Force satellite operations. The primary areas of research investigated by this project are solar phenomena, solar wind transport, and energization processes.

(U) FY 1999 ($ in Thousands)

(U) $1,887 Analyzed physics of solar magnetic fields, flares, and coronal mass ejections to provide a physical basis for predictive models of the effects of solar disturbances on near-Earth space to predict the state of the interplanetary medium using solar magnetic field and coronal data that can be related to disturbances.

(U) $2,580 Studied the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the Earth's magnetosphere, and evaluated techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances. Tested solar wind shock detection algorithms.

(U) $1,937 Studied magnetospheric and radiation belt processes to eliminate operational deficiencies, and fluid and particle dynamics to determine criteria for substorm onset and model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric propagation studies.

(U) $6,404 Total

(U) FY 2000 ($ in Thousands)

(U) $3,410 Analyze solar phenomena to characterize and model solar phenomena for much better prediction of large-scale disruptions in the space environment, and to advance development of protective spacecraft structures and defensive operational techniques. Investigate sunspots, solar oscillation modes, and solar magnetic fields to enable forecasting of solar eruptions.

(U) $2,130 Study solar wind transport to evaluate the magnetic transport of solar eruptions to formulate accurate maps of environmental vulnerability, and to identify orbits that ensure continued, reliable performance of Air Force satellites. Evaluate effects of the solar wind, the interplanetary magnetic field, and the Earth’s magnetosphere to enhance space weather specification and forecast models.

(U) $2,984 Study energization processes to examine the transient and long-term effects of the Earth's magnetospheric and radiation belt energization

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BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612311

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

processes to predict performance degradation levels in Air Force space systems. Examine charged particle dynamics for formulation of an accurate geomagnetic substorm onset model to calculate radiation effect longevity in the Earth's satellite environment. Investigate turbulence and ionospheric scintillation to enhance design and operation of surveillance, geolocation, and communication satellites.

(U) $8,524 Total

(U) FY 2001 ($ in Thousands)

(U) $5,957 Analyze solar phenomena to characterize and model solar phenomena for much better prediction of large-scale disruptions in the space environment, and to advance development of protective spacecraft structures and defensive operational techniques. Discover the physics of solar plasma arcades, solar flares, and coronal mass ejections to establish the physical basis for solar disturbance models. Continue investigating sunspots, solar oscillation modes, and solar magnetic fields to enable forecasting of solar eruptions, and predict risk to critical Air Force space operations.

(U) $4,467 Study solar wind transport to evaluate the magnetic transport of solar eruptions to formulate accurate maps of environmental vulnerability, and to identify orbits that ensure continued, reliable performance of Air Force satellites. Integrate solar magnetic field and coronal data to discover the science underpinning solar ejection paths and devise accurate modeling techniques. Evaluate effects of the solar wind, the interplanetary magnetic field, and the Earth's magnetosphere to enhance space weather specification and forecast models.

(U) $4,470 Study energization processes to examine the transient and long-term effects of the Earth's magnetospheric and radiation belt energization processes to predict performance degradation levels in Air Force space systems. Examine charged particle dynamics and magnetohydrodynamic fluid flow for formulation of an accurate geomagnetic substorm onset model to calculate radiation effect longevity in the Earth's satellite environment. Relate fundamentals of turbulence and ionospheric scintillation to enhance design and operation of surveillance, geolocation, and communication satellites.

(U) $14,894 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602601F, Space Technology.

(U) PE 0602702F, Command, Control, and Communications.

(U) PE 0603410F, Space System Environmental Interactions Technology.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	612311

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612312

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612312 Biological Sciences	12,256	13,326	13,556	13,671	13,632	13,540	13,481	Continuing	TBD

(U) A. Mission Description

Biological Science research explores the interaction of Air Force chemicals and physical agents (lasers and microwaves) with human tissues and their production of toxic effects to enable safety assessment strategies and to ensure the hazard-free development and use of future aerospace materials and directed energy systems. Research in biomimetic sensors strives to understand the biological detection systems of organisms at the molecular level and apply this understanding to the development of novel man-made sensors. Biocatalysis research aims to discover and characterize cellular enzymes that will catalyze the synthesis of chemical feedstocks used in the safe production of space and aerospace materials. Research in neuroscience and chronobiology will result in new strategies to prevent impaired performance due to jet lag and shift-work, night operations, and the loss of life and/or aircraft due to stress, inattention, or lack of vigilance. The primary areas of research investigated by this project are bioenvironmental sciences, biocatalysis, chronobiology and neural adaptation, and biomimetic sensors.

(U) FY 1999 ($ in Thousands)

(U) $4,972 Studied the effects of JP-8 jet fuel and its individual components on the lungs, brain, immune system, and skin of animals. Investigated computational and in vitro models for predicting chemical toxicity. Used molecular techniques to characterize changes in proteins and DNA derived from microwave-exposed animals. Developed the rationale for proposed new national safety standards for short-term retinal exposure to ultrashort laser pulses.

(U) $994 Researched mechanisms of infrared sensing systems in snakes and studied the sensory applications of novel microbial chromophores/ photophores for insights to military applications including space sensors.

(U) $299 Performed research to identify and characterize enzymes that catalyze intermediate products in polymer synthesis.

(U) $5,991 Investigated biological mechanisms responsible for circadian rhythmicity by examining individual differences in periodic responses to predict effects of night operations and jet lag on military personnel.

(U) $12,256 Total

(U) FY 2000 ($ in Thousands)

(U) $7,729 Study bioenvironmental sciences to investigate and predict biological effects of novel aerospace chemicals and directed energy systems to assure the safety, health, and high-performance of military personnel during and after mission-directed activities. Evaluate underlying biochemical alterations related to the adverse effects of JP-8 jet fuel. Explore in vitro biodynamic alterations that together with biokinetic parameters can aid in predicting toxicity and be integrated into the early computational design of new, safer, aerospace materials. Examine the effects of novel forms of directed energy (microwaves and lasers) on gene expression as an approach to identifying the specific sub-cellular targets of directed

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

energy.

(U) $1,333 Research biocatalysis to discover and characterize enzymes from living cells that can be used as biocatalysts to reduce cost, increase efficiency, and assure safety in the process of synthesizing chemical feedstocks used in the manufacture of aerospace materials. Identify and isolate bacteria strains capable of performing efficient biochemical reaction mechanisms to reduce cost and increase efficiency of the synthesis of aerospace materials.

(U) $2,665 Perform chronobiology and neural adaptation research to examine the biological mechanisms responsible for crew fatigue, adaptation to the environment, and individual performance capabilities to improve skilled human performance. Devise and test new preventative countermeasures for human errors induced by fatigue and jet lag, and perform fundamental research on the biophysical basis of alert cognitive performance.

(U) $1,599 Investigate biomimetic sensors to develop understanding of visual, auditory, and vestibular systems, and identify methods to enhance them. Investigate, predict, and model biological characteristics, behaviors, and functions for development of novel processes and mechanisms for physical and chemical system requirements. Devise techniques to model alternate mechanisms of near ambient infrared sensing systems in snakes and beetles to enable room-temperature, compact infrared sensors.

(U) $13,326 Total

(U) FY 2001 ($ in Thousands)

(U) $6,642 Study bioenvironmental sciences to investigate and predict biological effects of novel aerospace chemicals and directed energy systems to assure the safety, health, and high-performance of military personnel during and after mission-directed activities. Evaluate underlying biochemical alterations related to the adverse effects of JP-8 jet fuel and begin to identify specific protein targets responsible for triggering the toxic responses. Explore in vitro biodynamic alterations that together with biokinetic parameters can aid in predicting toxicity and be integrated into the early computational design of new, safer, aerospace materials. Examine the effects of novel forms of directed energy (microwaves and lasers) on gene expression and to identify the specific sub-cellular targets of directed energy.

(U) $3,389 Research biocatalysis to discover and characterize enzymes from living cells that can be used as biocatalysts to reduce cost, increase efficiency, and assure safety in the process of synthesizing chemical feedstocks used in the manufacture of aerospace materials. Various bacterial enzymes will be sub-cloned to enhance the level of gene expression so that the enzymes can be produced in sufficient yields for additional research and biotechnology development. Identify and isolate bacteria strains capable of performing efficient biochemical reaction mechanisms to reduce cost and increase efficiency of the synthesis of aerospace materials.

(U) $1,899 Perform chronobiology and neural adaptation research to examine the biological mechanisms responsible for crew fatigue, adaptation to the environment, and individual performance capabilities to improve skilled human performance. Interpret the mechanism by which serotonin regulates the circadian clock, determine if modafinil can prevent adverse effects on performance without disrupting sleep, and investigate the

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

		combination of countermeasures such as optimally-timed rest periods and wake promoting compounds.
(U)	$1,626	Investigate biomimetic sensors to develop understanding of visual, auditory, and vestibular systems, and identify methods to enhance them. Analyze, predict, and model biological characteristics, behaviors, and functions for development of novel processes and mechanisms for physical and chemical system requirements. Isolate and begin to model alternate mechanisms of near ambient infrared sensing systems in snakes and beetles to enable room-temperature, compact infrared sensors. Investigate and adapt chromophores and photoluminescent characteristics in microbial and protein-based biological systems for insights to military sensor applications.
(U)	$13,556	Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0602702F, Command, Control, and Communication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 612313

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
612313 Human Performance	11,790	13,057	13,211	12,708	12,307	11,929	10,934	Continuing	TBD

(U) A. Mission Description

Human Performance research examines all aspects of human information processing critical to Air Force operations. The overall objective is to develop useful, quantitative models of the way people: perceive, navigate, and manipulate their environment; make decisions in complex tasks under stress or uncertainty; and adapt to extreme sensory, biophysical, or cognitive workloads. The sensory component emphasizes visual, auditory, vestibular, and kinesthetic systems and their optimal integration. Focused investigations seek the scientific foundation for several developing Air Force technologies including the design of interactive displays, virtual reality simulators, intelligent control systems, sensors and fused-image displays, and adaptive systems for personnel training and selection. The primary areas of research investigated by this project are sensory and perceptual systems, cognition, and cognitive workload.

(U) FY 1999 ($ in Thousands)

(U) $3,145 Performed sensory and perceptual system analysis for human-machine interface and image exploitation by developing image representation theory and investigating algorithms for visual attention to improve performance in command and control environments; also supported model-based predictions of limits in speech communication.

(U) $4,528 Conducted cognitive workload analysis for crew training and performance enhancement by examining cognitive performance models, developing a theory of cognitive workload, and extending the cognitive models to include characterization of on-line job aiding systems used in command and control environments.

(U) $4,117 Studied synthetic task environments for baseline performance measurement, and conducted experiments leading to a more general theory of utility for performance enhancement techniques. Extended experimental techniques for command and control team performance and developed multi-ship modeling for uninhabited aerial vehicles (UAV) surveillance and targeting.

(U) $11,790 Total

(U) FY 2000 ($ in Thousands)

(U) $3,525 Perform sensory and perceptual system research to investigate sensory and perceptual systems to enhance human-machine interaction in Air Force weapon systems. Expand theories of visual search and scene analysis and control of attention for optimal cockpit performance. Investigate the perceptual and cognitive requirements for accurate simulation of virtual environments.

(U) $4,962 Conduct cognition research to measure and analyze cognitive dimensions of human performance in complex command and control tasks with multiple crew-member interactions. Formulate models of intelligent systems that aid human behavioral and cognitive functions or compensate for human limitations.

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BUDGET ACTIVITY 01 - Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT 612313

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

(U)	$4,570	Study cognitive workload research to formulate behavioral and physiological measures of cognitive workload, alertness, and vulnerability to sleep loss to enable cognitive performance modeling and prediction. Devise innovative approaches to understanding individual skill differences, and identify new training and selection system models relevant to modern, technology-dependent environments.
(U)	$13,057	Total

(U) FY 2001 ($ in Thousands)

(U)	$3,567	Perform sensory and perceptual system research to investigate sensory and perceptual systems to enhance human-machine interaction in Air Force weapon systems. Refine theories of visual search and scene analysis, control of attention, perception of orientation, and localization of sound for optimal cockpit performance. Analyze the perceptual and cognitive requirements for accurate simulation of virtual environments and for effective design of informative displays. Understand human multisensory integration to enable the design of automated sensing devices.
(U)	$5,021	Conduct cognition research to measure and analyze cognitive dimensions of human performance in complex command and control tasks with multiple crew-member interactions. Enhance human performance via intelligent systems that aid human behavioral and cognitive functions or compensate for human limitations. Develop and test training protocols to maximize team effectiveness under stress and sustained operation.
(U)	$4,623	Study cognitive workload to formulate behavioral and physiological measures of cognitive workload, alertness, and vulnerability to sleep loss to enable cognitive performance modeling and prediction. Invent innovative approaches to understanding individual skill differences, and create new training and selection systems relevant to modern, technology-dependent environments. Study behavioral and physiological measures to avert human error in conditions of information overload and fatigue.
(U)	$13,211	Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602202F, Human Effectiveness Applied Research.

(U) PE 0602702F, Command, Control, and Communication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

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01 - Basic Research	0601102F Defense Research Sciences	612313

(U) E. Schedule Profile Continued

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 01 - Basic Research

PE NUMBER AND TITLE: 0601102F Defense Research Sciences

PROJECT: 614113

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
614113 External Research Programs Interface	12,462	4,821	4,385	3,818	3,056	2,198	0	Continuing	TBD

(U) A. Mission Description

International and domestic interchange research programs optimize the interaction between the international research community and Air Force researchers, and stimulate scientific and engineering education beneficial to the Air Force. The programs increase the awareness of Air Force basic research priorities and attracts talented scientists and engineers to address its needs. The primary elements of this effort are international strategy, international technology liaison, and scientist and engineer education research interchange.

(U) FY 1999 ($ in Thousands)

(U) $4,112 Funded international science and personnel exchange programs.

(U) $4,890 Supported technology liaison missions in Europe and Asia to support scientists and engineers performing research in international laboratories.

(U) $3,460 Provided Air Force share of funding for North Atlantic Treaty Organization (NATO) affiliated research institutes.

(U) $12,462 Total

(U) FY 2000 ($ in Thousands)

(U) $1,590 Support the Air Force Research Laboratory international strategy mission to provide centralized international expertise to assist formulation of optimal cooperation with, and leveraging of, international science programs to the benefit of the Air Force. Provide primary interface with the Office of the Secretary of Defense, the Office of the Secretary of the Air Force, and Air Force Materiel Command to coordinate international participation among appropriate U.S. Department of Defense organizations.

(U) $1,891 Support international technology liaison missions to identify unique international research capabilities, and make them available to the U.S. Air Force. Use the European Office of Aerospace Research and Development and the Asian Office of Aerospace Research and Development to provide on-site coordination with international research organizations, and support international visits of high level Department of Defense delegations. Sustain and fund Air Force commitment to NATO-affiliated research institutes, such as the Von Karman Institute.

(U) $1,340 Support scientist and engineer research interchange to assure the Air Force of continuing availability of superior scientific and engineering talent by supporting exceptional individuals and forging associateships between premiere scientists and the Air Force Research Laboratory. Improve awareness of Air Force research needs throughout the civilian scientific community while simultaneously identifying and recruiting the best scientific talent to participate in critical Air Force research.

(U) $4,821 Total

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$1,447	Support the Air Force Research Laboratory international strategy mission to provide centralized international expertise to assist formulation of optimal cooperation with, and leveraging of, foreign science programs to the benefit of the Air Force. Provide the primary interface with Office of the Secretary of Defense, the Office of the Secretary of the Air Force, and Air Force Materiel Command to coordinate international participation among appropriate U.S. Department of Defense organizations.
(U)	$1,720	Support international technology liaison missions to identify unique international research capabilities, and makes them available to the U.S. Air Force. Use the European Office of Aerospace Research and Development and the Asian Office of Aerospace Research and Development to provide on-site coordination with international research organizations, and support international visits of high level Department of Defense delegations. Sustain and fund Air Force commitment to NATO-affiliated research institutes, such as the Von Karman Institute.
(U)	$1,218	Support scientist and engineer education to assure the Air Force of continuing availability of superior scientific and engineering talent by supporting exceptional individuals and forging associateships between premiere scientists and the Air Force Research Laboratory. Improve awareness of Air Force research needs throughout the civilian scientific community while simultaneously identifying and recruiting the best scientific talent to participate in critical Air Force research.
(U)	$4,385	Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0601103D, University Research Initiative.
(U) PE 0602102F, Materials.
(U) PE 0602202F, Aerospace Flight Dynamics.
(U) PE 0602202F, Human Effectiveness Applied Research.
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602204F, Aerospace Avionics.
(U) PE 0602269F, Hypersonic Technology Program.
(U) PE 0602601F, Space Technology (formerly Phillips Lab).
(U) PE 0602602F, Conventional Munitions.
(U) PE 0602702F, Command, Control and Communication.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
01 - Basic Research	0601102F Defense Research Sciences	614113

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.